SECTION 16115

UNDERGROUND DUCTBANKS AND MANHOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

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Edit the list to match Project requirements.
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A. Underground ductbanks for power.

B. Underground ductbanks for communications.

C. Power manholes.

D. Communications manholes.

1.2 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70—*National Electrical Code* and ANSI C2—*National Electrical Safety Code*.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. (UL) as suitable for purposes specified and shown.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to prevent damage.

B. Accept conduits on the site. Inspect for damage.

C. Protect PVC conduits from sunlight and entrance of debris.

1.4 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of duct banks before excavation for rough-in.

C. Duct bank routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete duct system.

1.5 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01300.

1. Catalog Data for pre-cast manhole.

2. Catalog Data for manhole frame and lid.

3. Report of duct blockage tests

PART 2 PRODUCTS

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Edit 2.1 through 2.6 to match Project requirements. Delete 2.1 through 2.5 if the specification set includes Section 16111.

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2.1 INTERMEDIATE METAL CONDUIT AND FITTINGS

A. Furnish galvanized intermediate metal conduit (IMC) that conforms to the requirements of UL1242—*Intermediate Metal Conduit*, ANSI C80.6—*Intermediate Metal Conduit*, and ANSI/NFPA 70, Article 345.

B. For intermediate metal conduit, furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that conform to the requirements of UL514B—*Fittings for Conduit and Outlet Boxes,* and ANSI/NEMA FB1—*Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies*.

2.2 RIGID GALVANIZED STEEL CONDUIT AND FITTINGS

A. Furnish rigid galvanized steel conduit (RGS) that conforms to the requirements of UL6— *Rigid Metal Electrical Conduit*, ANSI C80.1—*Rigid Steel Conduit, Zinc Coated*, and ANSI/NFPA 70, Article 346.

B. For rigid galvanized steel conduit, furnish zinc-plated, threaded, malleable iron fittings and conduit bodies that conform to the requirements of UL514B and ANSI/NEMA FB1.

2.3 PLASTIC-COATED STEEL CONDUIT AND FITTINGS

A. Furnish PVC exterior coated, urethane interior coated, galvanized rigid steel conduit or intermediate metal conduit that conforms to the requirements of NEMA RN 1—*PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit*.

B. Provide factory-fabricated elbows for sizes 2 inches and larger.

C. For plastic-coated steel conduit, furnish 40 mil PVC exterior coated, urethane interior coated, zinc-plated, threaded, malleable iron fittings and conduit bodies that conform to the requirements of UL514B—*Fittings for Conduit and Outlet Boxes* and NEMA RN 1—*PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit*.

2.4 RIGID NON-METALLIC CONDUIT AND FITTINGS

A. Furnish rigid non-metallic conduit (PVC) that conforms to the requirements of UL651—*Rigid Nonmetallic Electrical Conduit,* NEMA TC 2—*Electrical Plastic Tubing and Conduit,* ANSI C80.3, and NFPA 70, Article 347.

B. For rigid non-metallic conduit, furnish non-metallic, solvent-welded socket fittings that conform to the requirements of UL514C—*Non-Metallic Fittings for Conduit and Outlet Boxes,* and NEMA TC 3—*PVC Fittings for Use with Rigid PVC Conduit and Tubing*.

2.5 CORROSION PROTECTION TAPE

A. Furnish pressure-sensitive, 10 mil thick. PVC based tape for corrosion protection of metal conduit and fittings.

B. Manufacturer: 3M, Type 50.

2.6 UTILITIES DUCT AND FITTINGS

A. Furnish PVC type EB, 90 ºC rated, utilities duct for concrete encasement that conforms to the requirements of NEMA TC 6—*Plastic Utilities Duct for Underground Installation*, ANSI C130.2, ASTM F-512—*Standard Specification for Smooth-Wall PVC Conduit and Fittings for Underground Installation*, and UL-651A.

B. For utility duct, furnish PVC fittings that conform to NEMA TC *9—Fittings for Plastic Utilities Duct for Underground Installation* and ASTM F-512—*Standard Specification for Smooth-Wall PVC Conduit and Fittings for Underground Installation*.

2.7 DUCT SPACERS

A. Furnish duct spacers that provide 2 inch separations between ducts and minimum 3 inch concrete coverage on bottom sides and top.

B. Manufacturers: Underground Products "Vertical Lock," Underground Products "Wunpeece," Condux International "Formex."

2.8 CONCRETE

A. Use concrete with maximum ½ inch coarse aggregate and Type 1 Portland cement (ASTM C 150, *Standard Specification for Portland Cement*) that has a slump of 6 to 7 inches and acquires a compressive strength of 2500 psi in 28 days. See Section 03300 for concrete mix design requirements.

B. Color concrete red for permanent marking of ductbanks containing medium voltage cables.

1. Use 2.0 lb. of pigment per 94 lb. sack of cement.

2. Manufacturer: Rockwood Industries/Davis Colors, No. 1117.

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Edit 2.9 to match Project requirements; delete if specification set includes Section 16195.

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2.9 UNDERGROUND WARNING TAPE

A. Furnish underground warning tape for underground duct banks.

B. Use 6 inch wide, 0.004 inch thick, polyethylene underground warning tape with the following background colors:

1. Electric: Red

2. Telephone/Data: Orange

C. Lettering shall be black and indicate the type service buried below.

1. Electric: "CAUTION ELECTRIC LINE BURIED BELOW"

2. Telephone/Data: "CAUTION TELEPHONE LINE BURIED BELOW"

D. Manufacturer: Seaton, Style No. 210ELE and 210TEL

2.10 MEASURING AND PULLING TAPE

A. Furnish coated, synthetic measuring and pulling tape with a minimum width of 1/4 in. and a minimum tensile strength of 900 lb.

B. Manufacturer: George-Ingraham, #9214-JK.

2.11 GROUND CABLE

Provide No. 4/0 AWG bare stranded, soft temper copper cable that conforms to ASTM B 8, *Standard Specification for Concentric-Lay Stranded Copper Conductors*.

2.12 PRE-CAST MANHOLES

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Edit manhole size(s) to match Project requirements.
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A. Provide pre-cast concrete electrical manholes that conform to the requirements of ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, with the following minimum inside dimensions: 12'-0" long, 6'-0" wide, 7'-0" high.

B. Minimum thickness of floor, walls and roof shall be 6 inches.

C. Minimum design loading shall be 300 lb. per sq. ft.; design loading shall conform to AASHTO HS-20 where manhole is installed below the street or paved parking area.

D. Manhole floor shall be cast integral with walls to form the bottom ring.

E. Provide a keyed joint between the bottom ring and top ring.

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Edit knockout sizes and locations to match Project requirements.
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F. Provide 30 in. X 30 in. knockout panels, one in each end wall and two in each side wall of manhole.

G. Provide a 12 inch diameter sump hole with cast iron cover in the floor.

H. Provide a 36 inch diameter access opening centered in the roof of the manhole.

I. Provide pre-cast concrete grade rings as required to place top of manhole flush with paving or 2 to 4 in. above finished grade. Grade rings shall have a minimum inside diameter of 36 inches. Provide cast iron manhole steps at 16 in. on-centers.

J. Provide lifting inserts in each manhole section for unloading and positioning.

K. Provide one hot dip galvanized steel pulling iron under each knockout panel and one under the manhole access opening. Pulling iron shall have a capacity of 8000 lb. with a safety factor of 2.

L. Provide 1-5/8 in. X 1-5/8 in. hot dip galvanized steel continuous inserts embedded in each side wall of manhole.

1. Position inserts horizontally and space 20" apart with bottom insert 12 in. above the floor.

2. Extend inserts to within 6 in. of end walls.

3 Manufacturer: Unistrut, P3200 series.

M. Manufacturers: ARCO Concrete, Inc., Carder Precast, Pre-Cast Manufacturing, Co., 4-Corners Pre-Cast.

2.13 PREMOLDED JOINT FILLER

A. Provide a closed cell expanded neoprene joint filler conforming to ASTM D1056, *Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber*.

B. Manufacturer: Williams Products, Inc., Type NN-1

2.14 COLD APPLIED ASPHALT EMULSION DAMP-PROOFING

A. Provide asphalt-water emulsion coating, compounded to penetrate precast concrete substrate and build to a moisture-resistant coating.

B. Emulsion shall be non-fibrated, asbestos-free liquid conforming to ASTM D1227, Type III.

C. Manufacturers: ChemRex, Inc./Sonneborne Building Products Div., Karnak Chemical Corporation.

2.15 MANHOLE ACCESSORIES

A. Provide heavy duty cast iron manhole frame with solid lid.

1. Material shall conform to ASTM A48, *Standard Specification for Gray Iron Castings*, Class 35B.

2. Frame and lid shall be suitable for AASHTO HS-20 wheel loads.

3. Minimum clear opening through the frame will be 30 inches.

4. Provide lid lettering "ELECTRIC" for power manhole and "TELEPHONE" for communications manhole.

5. Manufacturer: Neenah Foundry Company, Model R-1640-C1

B. Provide hooked manhole ladder that complies with OSHA 29 CFR 1910.27 and ANSI A14.3—*Safety Code for Fixed Ladders*.

1. Ladder shall be fabricated from steel conforming to ASTM A36, *Standard Specification for Structural Steel*.

2. Paint manhole ladder as follows: One coat of rust inhibiting primer, 2 - 3 mil minimum wet thickness. Two finish coats of water based alkyd enamel, 3 mil minimum wet thickness, safety yellow color.

3. Manufacturer: George-Ingraham Corp.

C. Provide heavy duty non-metallic cable racks and arms for manholes.

1. Each member shall be molded in one piece from UL listed glass reinforced nylon that can be field cut to length.

2. Provide 14 in. long arms.

3. Manufacturer: Underground Devices, Inc., #CR36 rack and #RA14 arm.

D. Use hot dip galvanized, electro-galvanized or stainless steel hardware in manholes.

2.16 DUCT PLUGS

A. Provide rubber duct plugs that will produce a positive seal in unused ducts against water and

gas. Plugs shall be made of soft, expansible rubber compressed with galvanized steel plates and bolts.

B. Manufacturer: George-Ingraham, #0609 through #0616.

2.17 DUCT SEALANT

A. Provide smoke sealant and fire barrier latex caulk that has intumescent and endothermic properties and has UL Classified system ratings of up to four hours.

C. Manufacturer: 3M, type CP 25WB+ Caulk

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate underground ductbank and manhole work to avoid interference with other trades.

B. Position trenches so ductbanks will have the following minimum separations from parallel perpendicular runs other utility pipes or conduits.

UTILITY TYPE	PARALLEL	PERPENDICULAR
Water	24"	12" above water pipe
Gravity Sewer	24"	12" above sewer pipe
Force Main Sewer	24"	12" above force main
Natural Gas	60"	12" below gas pipe*
Steam or Hot Water	24" if insulated, 48" if not	12" if insulated, 24" if not
Open Communications	12" of tamped soil or 3" of concrete	12" of tamped soil or 3" of concrete
Secure Communications	24" of tamped soil or 6" of concrete	24" of tamped soil or 6" of concrete
Electrical	12" of tamped soil or 3" of concrete	12" of tamped soil or 3" of concrete

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The Drawings should contain detail(s) reflecting the requirements in LANL design standard drawing ST3211.

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3.2 EXCAVATION AND BACKFILL

A. Make excavation for manholes and underground ductbanks to depth required and to provide solid bearing. Set excavation so top of ductbank will be not less than 24 in. below finished grade or paving.

B. Grade trenches for underground ductbanks to a minimum of 4 inches per 100 ft. toward manholes.

C. Keep excavation dry during installation of work.

D. Make trenches of sufficient width to receive work to be installed and provide specified concrete coverage on sides.

E. Backfill in 6 inch layers; use soil excavated; remove roots, rocks and sharp objects. Provide coarse sand as required for additional backfill material.

F. Moisture condition backfill soil and compact in accordance with ASTM D 1557 to 95% maximum density under paved areas and 90% maximum density under unpaved areas.

G. Overfill trenches to allow for settlement.

3.3 UNDERGROUND DUCTBANK INSTALLATION

A. Install the number and size of ducts as indicated on the Drawings.

B. Use the following duct materials:

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Edit 1 through 4 to match Project requirements.
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1. Use Schedule 40 rigid non-metallic conduit, Type EB utility duct, galvanized intermediate metal conduit, or rigid galvanized steel conduit for low voltage lighting, power or control wiring.

2. Use Schedule 40 rigid non-metallic conduit, Type EB utility duct, galvanized intermediate metal conduit, or rigid galvanized steel conduit for communications ducts.

3. Use Schedule 40 rigid non-metallic conduit, Type EB utility duct, galvanized intermediate metal conduit, or rigid galvanized steel conduit for utility level medium voltage power ducts.

4. Use plastic-coated galvanized rigid steel conduit, tape-wrapped galvanized intermediate metal conduit, or tape-wrapped rigid galvanized steel conduit for elbow and riser where ducts turn up to the surface.

C. Terminate ducts in manholes, vaults and building walls using bell end fittings.

1. For ducts installed through holes cut in existing building, vault or manhole walls, pack opening with non-shrink grout. Feather the edge of the grout around each bell and conform to the curvature of the bell end. Remove sharp edges and projections and fill voids within 6 inches of bell ends.

2. For concrete-encased ducts installed in new manholes through a knockout panel, after removing forms from the end of the ductbank, rub the exposed concrete surface smooth. Feather the edge of the concrete around each bell and conform to the curvature of the bell end. Remove sharp edges and projections and fill voids within 6 inches of bell ends.

D. Ground metallic conduit exposed to contact according to the requirements of NFPA 70. Use exothermic welded connections for concealed grounding connections.

E. Grade ducts to drain to manholes; do not trap ducts.

F. Use the smooth earth walls of trenches as forms for concrete encasement of ducts.

G. Make changes in direction of duct runs using long sweep bends with a minimum radius of 25 feet. Where ducts turn up into the surface, use RGS, IMC or PVC coated rigid steel elbows with minimum 36 in. radius; terminate in a coupling 4 in. above the surface or equipment pad. Install zinc-plated malleable iron pipe plug in each unused duct stub-up.

H. Support ducts with duct spacers placed at intervals not exceeding 5 ft.

I. Anchor ducts to bottom of trench using reenforcing steel and wire at intervals not exceeding 10 ft.

J. Install a #4/0 AWG bare copper ground cable centered within each ductbank; connect to ground cable in manholes using exothermic welds or IEEE 467 certified compression connectors.

K. Make-up joints in underground ducts to be tight, driven home on both sides and thoroughly waterproof. On non-metallic ducts use manufacturer's recommended solvent-cement. On metallic conduits, coat male threads with red colored, alkyd base, “tank and structural” primer that is suitable for galvanized steel; make up fittings wrench-tight.

L. Where metallic conduits exit concrete encasement, use plastic coated rigid steel conduit or tape wrap with corrosion protection tape, half-lapped. Wrap IMC or RGS conduit 12 in. on each side of exit point and wrap all metal conduit in contact with earth.

M. Encase underground ducts in concrete to provide not less than 3 inches of coverage on all sides. Use red concrete for ductbanks containing medium voltage cables. Place concrete using deflecting trough directing concrete through the duct assembly. Allow for expansion/contraction of ducts; place concrete starting at one end of ductbank allowing the free end to move.

N. Place concrete envelope as one monolithic pour where possible; taper any joints with a 10:1 slope.

O. Test each duct for blockage or deformation after concrete has cured for 24 hours.

1. Use a flexible mandrel/scraper not less than 12 in. long with a diameter approximately 1/4 in. less than the inside diameter of the duct.

2. Pull a mandrel behind a brush with stiff bristles.

3. Replace any duct section found blocked.

4. Notify Contract Administrator 10 days before duct tests; submit written reports of tests to Contract Administrator.

P. After ducts have been successfully tested, backfill the trench. Place underground warning tape in backfill 12 inches below the surface.

Q. Install measuring and pulling tape in each duct.

3.4 MANHOLE INSTALLATION

A. Install manholes at locations indicated on the Drawings.

B. Make excavation of suitable dimensions so ducts enter manhole at proper elevation and so waterproofing can be applied on exterior of in-place manhole.

C. Install a minimum 6 in. sand bedding under manholes; compact to 95% maximum density accordance with ASTM D 1557.

D. Install a 2 ft. X 2 ft. X 2 ft. sump of 3/4 in. gravel below the drain sump opening in the bottom ring of the manhole.

E. Place premolded joint filler in joints between bottom ring, top ring, grade rings and manhole frame. Install following manufacturer's instructions.

F. Apply liquid asphalt emulsion dampproofing material to exterior surfaces of manholes by brushing or spraying at a rate of 1.5 to 2.5 gallons per 100 sq. ft., depending on substrate texture, to produce a dry film thickness of not less than 15 mils. Apply multiple coats if necessary to obtain required thickness; allow drying time between coats.

G. Install a continuous loop of #4/0 AWG bare copper ground cable around inside walls of manholes at floor level.

1. Attach to walls using copper or cast bronze cable holders and masonry anchors.

2. Connect to duct bank ground cable using exothermic welds or approved non-reversible compression fittings.

3. Ground metallic conduits or duct bell ends to ground cable loop using exothermic welds or approved non-reversible compression fittings.

4. Ground metal cable racks and permanent ladders using exothermic welds or approved non-reversible compression fittings.

H. Install cable racks as required to support cables at intervals not exceeding 3 ft.

3.5 DUCT PLUGGING AND SEALING

A. Install duct plugs in both ends of all unused ducts that cross any natural gas line.

B. Install duct sealant in both ends of all ducts containing cables that cross any natural gas line.

END OF SECTION